Renal and Urinary Tract Anatomy

Khushi Patel - Year 2
23/04/2024

Learning Objectives

- Describe the **structure** of the whole **kidney**
- Describe the histological features of the: **renal corpuscle**, filter (**glomerulus** and **podocytes**), **convoluted tubules**, **loop of Henle, juxtaglomerular apparatus, collecting ducts, papilla, ureter** and **bladder**
- Give a detailed account of the anatomy of the structure of the **ureter**, its arterial supply, innervation, its course and relations
- Describe the structure of the **bladder**, its innervation, and an account of its relations
- Give an account of the **prostate gland**, list its anatomical relations, the arterial supply, venous and lymphatic drainage
- Describe the anatomy of the **urethra** and give an account of its different parts in males and females

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The Urinary System

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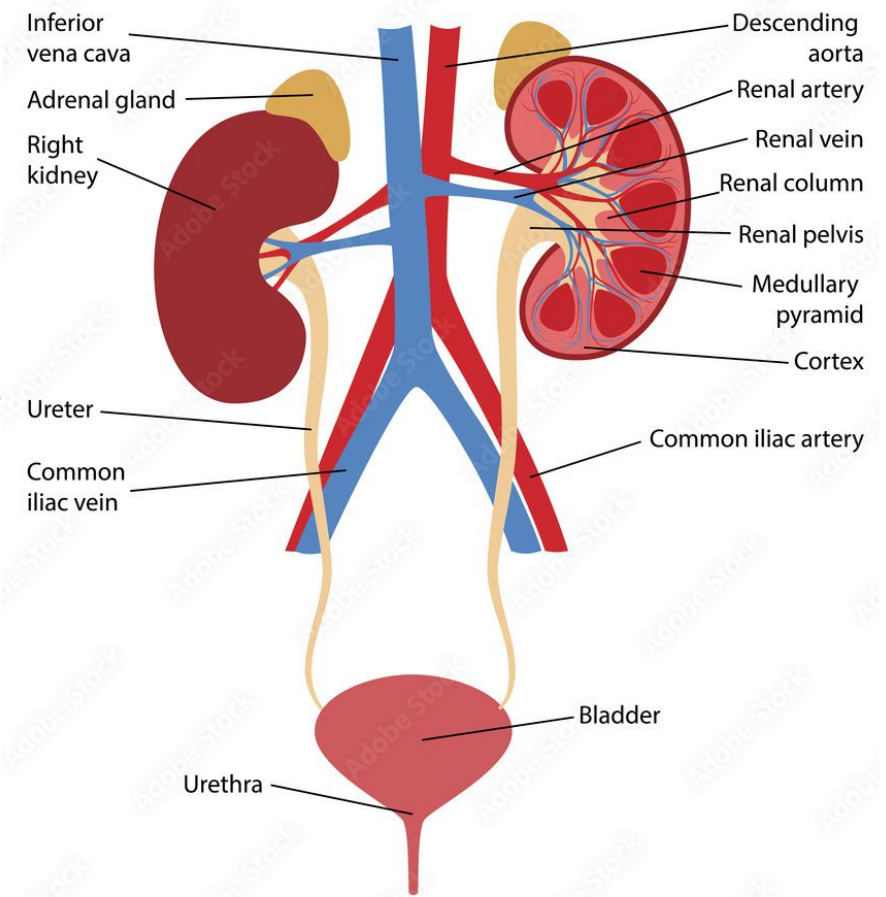
- 2 kidneys
- 2 ureters
- 1 bladder
- 1 urethra
- Urine produced in the kidneys is conducted by the ureters to the bladder where it is stored until voided via the urethra
- Blood supply: renal arteries arise from the abdominal aorta
- One or more renal veins drain each kidney to the inferior vena cava



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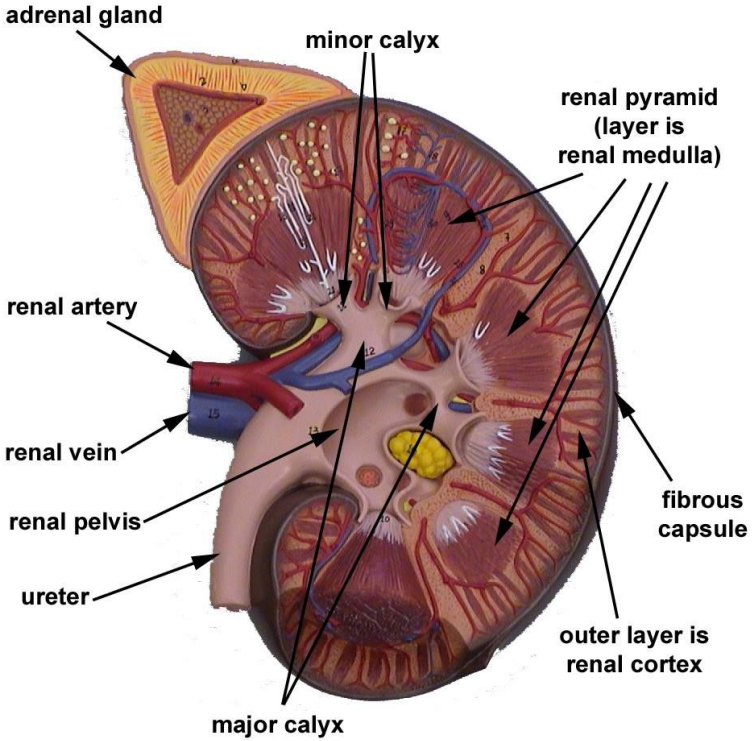
Kidney

Structure of the Kidney

- Consists of (outer) cortex and (inner) medulla
- Medullary pyramids (cone-shaped masses of medullary substance) project into subdivisions of the renal pelvis (calyces)
- The renal pelvis narrows as it leaves the kidney to give the ureter
- The hilum: site of entry and exit of the renal blood vessels and ureter
- The whole kidney is surrounded by a fibrous capsule, which also surrounds the attached adrenal gland. Also surrounded by a thick layer of fat – protection against impact trauma.



Histological features of the Kidney

- A nephron is the functional unit of the kidney; consists of renal corpuscle and renal tubule
- Renal corpuscle – plasma filtration, consists of 2 structures:

  • Bowman's capsule (BC); distended, blind end of the renal tubule

  • Glomerulus (G); packed capillaries that invaginate Bowman's capsule derive from the afferent arteriole

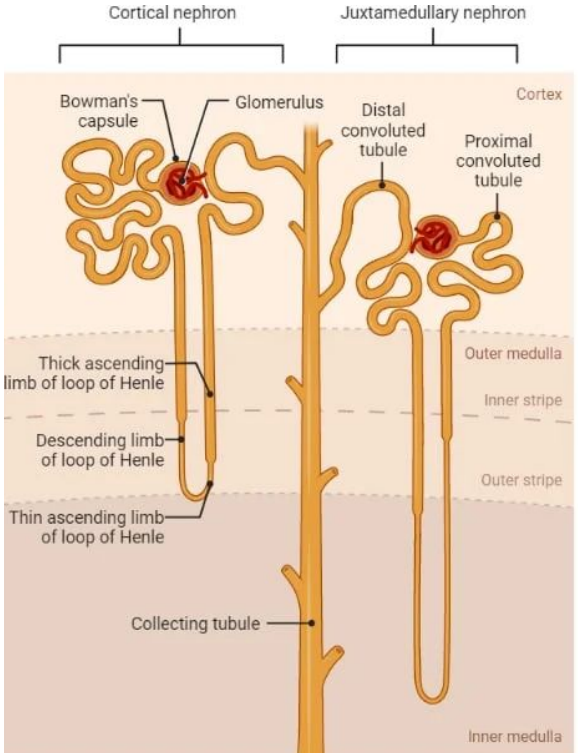
- Renal tubule – reabsorption, extends from Bowman's capsule to the collecting duct. Convoluted in shape, 4 histological-physiological zones

  a: proximal convoluted tubule (PCT)

  b: loop of Henle

  c: distal convoluted tubule (DCT)

  d: collecting tubule (CT)

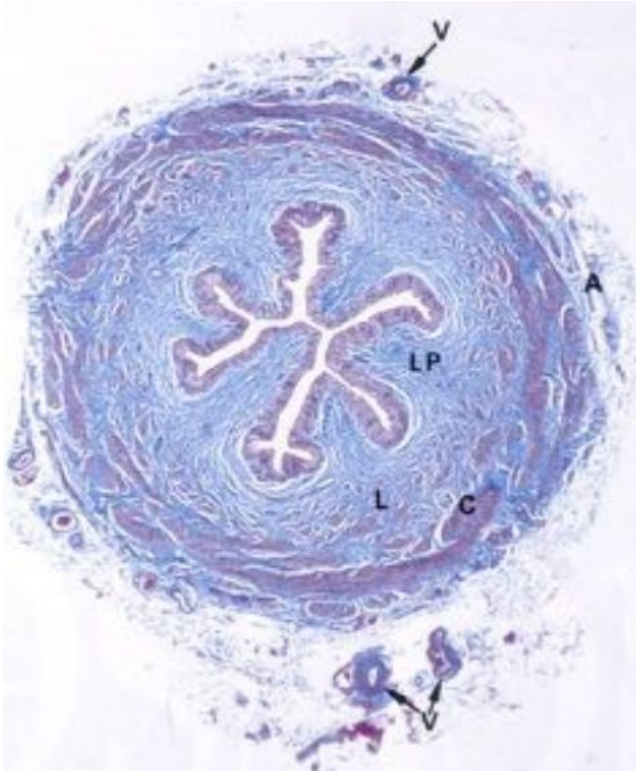


Questions?

Urinary Tract

Ureter

- Muscular tube that conducts urine from the kidney to the bladder
- Urine moves by peristaltic action of ureteric wall
- Two layers of smooth muscle:
  - Longitudinal (L); inner layer and really an elongated spiral
  - Circular (C); outer layer and also a (tight) spiral
- Lumen of ureter is lined by transitional epithelium, with deep lamina propria rich in collagen (LP)
- An adventitia surrounds ureter: note the arteries (A) and veins (V)
- Blood supply: Ureteric branches of Abdominal Aorta



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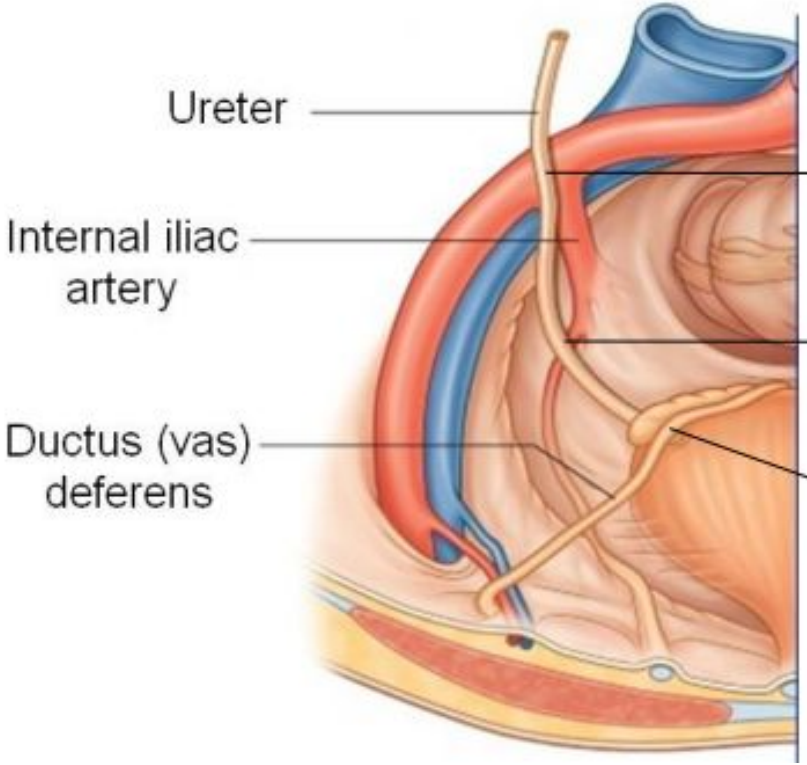
Pelvic Course of Ureter in Males



Crosses over the external iliac artery

Crosses over the obliterated umbilical artery

Crosses under the ductus (vas) deferens

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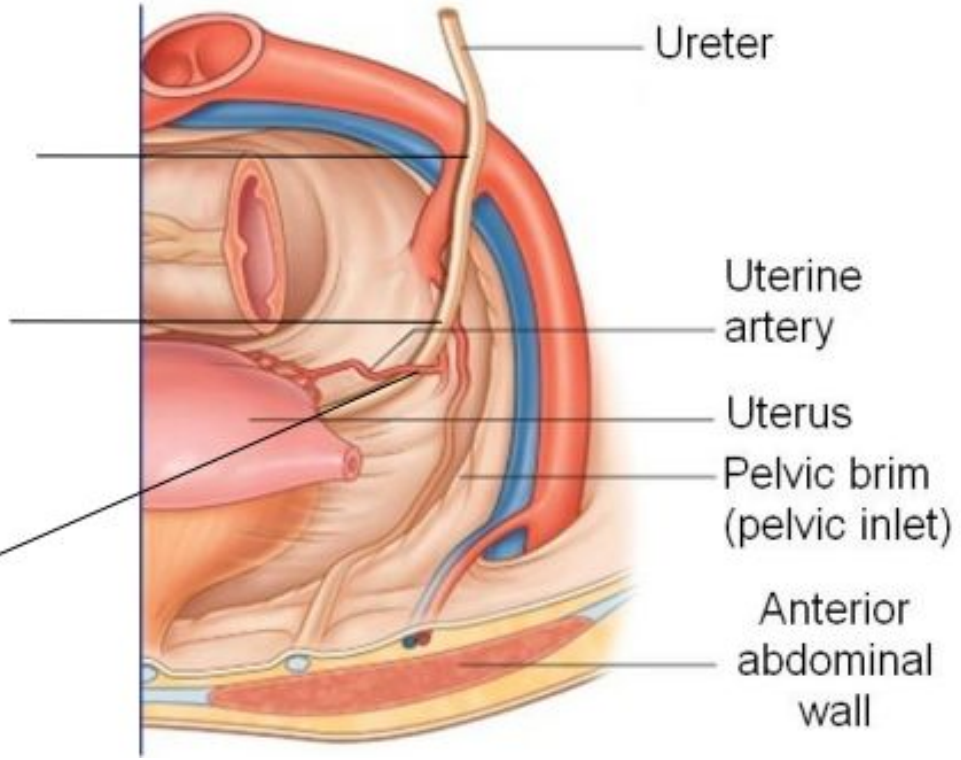
Pelvic Course of Ureter in Females

Crosses over the external iliac artery

Crosses over the obliterated umbilical artery

Crosses under the uterine artery



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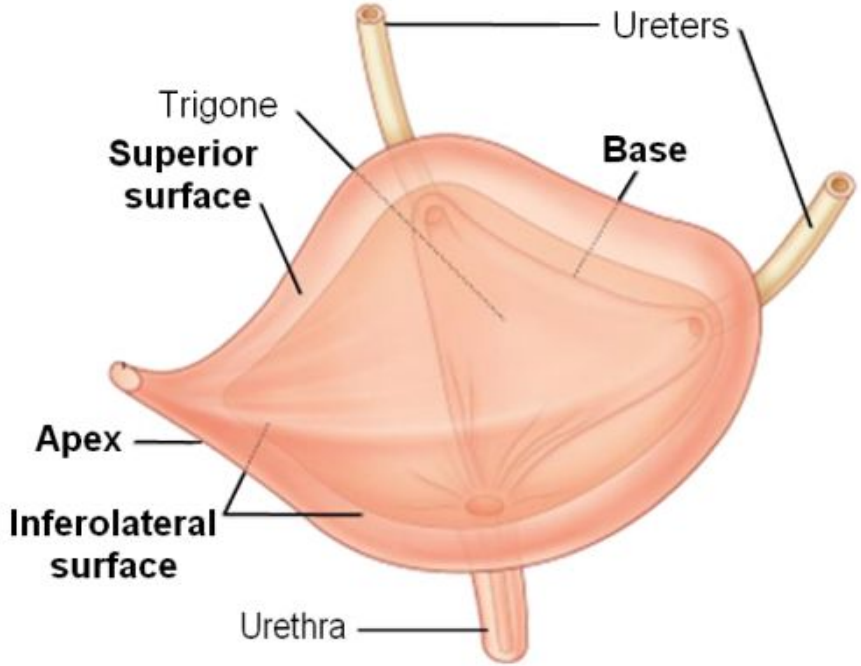
Bladder

- The urinary bladder is essentially a muscular bag, shaped like a lop-sided pyramid
- Its walls are composed of smooth muscle, known as the “detrusor muscle”
- The base is known as the “trigone” and is positioned posteroinferiorly, whilst the apex is positioned anterosuperiorly
- The sides of the bladder are angled downwards and form an inferolateral surface
- The actual shape of the bladder is dictated by how full it is
- As it fills the superior surface extends upwards, whilst the base remains relatively fixed
- When the bladder is empty, the walls of the bladder are rugged, but the trigone is smooth
- As the bladder fills with urine, its rugged walls smooth out, and its epithelium (urothelium) is stretched.



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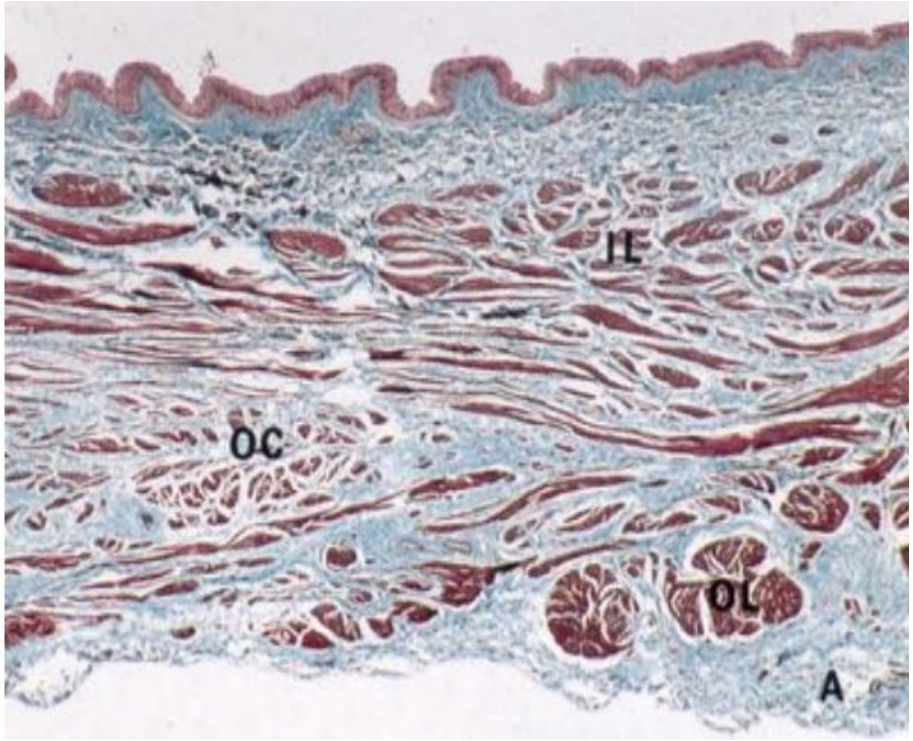
Bladder

- Wall of bladder consists of 3 smooth muscle layers (as does lower section of ureter) and abundant elastic fibres.
  - IL: inner longitudinal
  - OC: outer circular
  - OL: outermost longitudinal
- The adventitia (A) contains arteries, veins and lymphatics.
- In this example, the bladder is relaxed (void) so the transitional epithelium is thrown into folds.
- The bladder has a supply from the superior and inferior vesical arteries, branch of internal iliac artery



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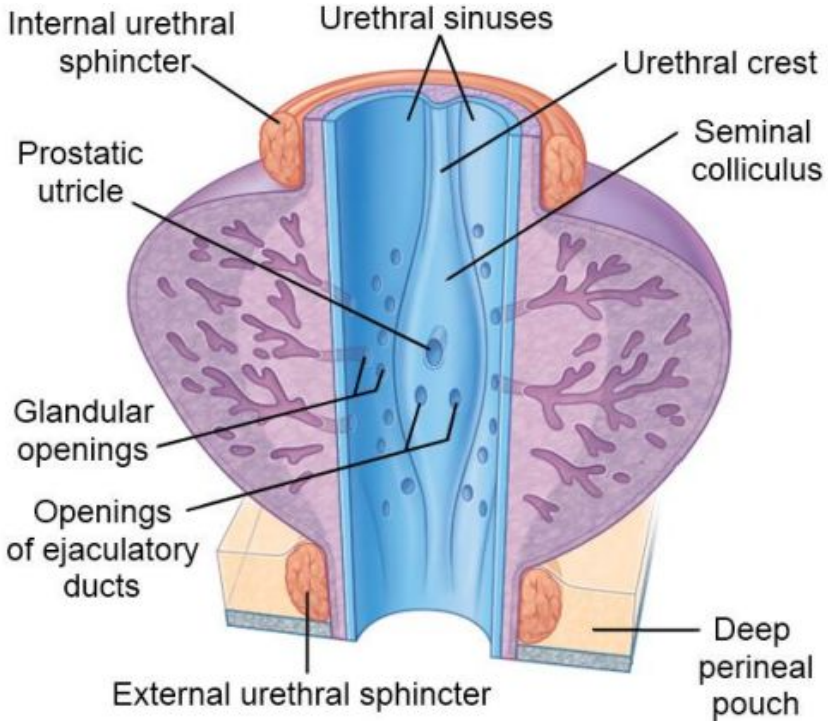
Prostate Gland

- The adult prostate gland is said to be ‘walnut-sized’
- The prostate encloses the urethra, and its secretions drain directly into the lumen of the urethra via several prostatic ducts
- On the posterior wall of the prostatic urethra is a swelling, known as the seminal colliculus
- Superiorly, this narrows to form the urethral crest, and this in turn is connected to the trigone of the bladder
- There are three openings into the seminal colliculus
- Superiorly, there is a small, blind ended opening, the prostatic utricle
- Below it are the paired openings of the ejaculatory ducts, the unified ducts of the ductus (vas) deferens and the seminal vesicles
- Innervation: Pelvic splanchnic nerves S2- S4 (parasympathetic), Inferior hypogastric plexus (sympathetic)
- The prostate is supplied by the inferior vesical arteries, branch of the internal iliac artery



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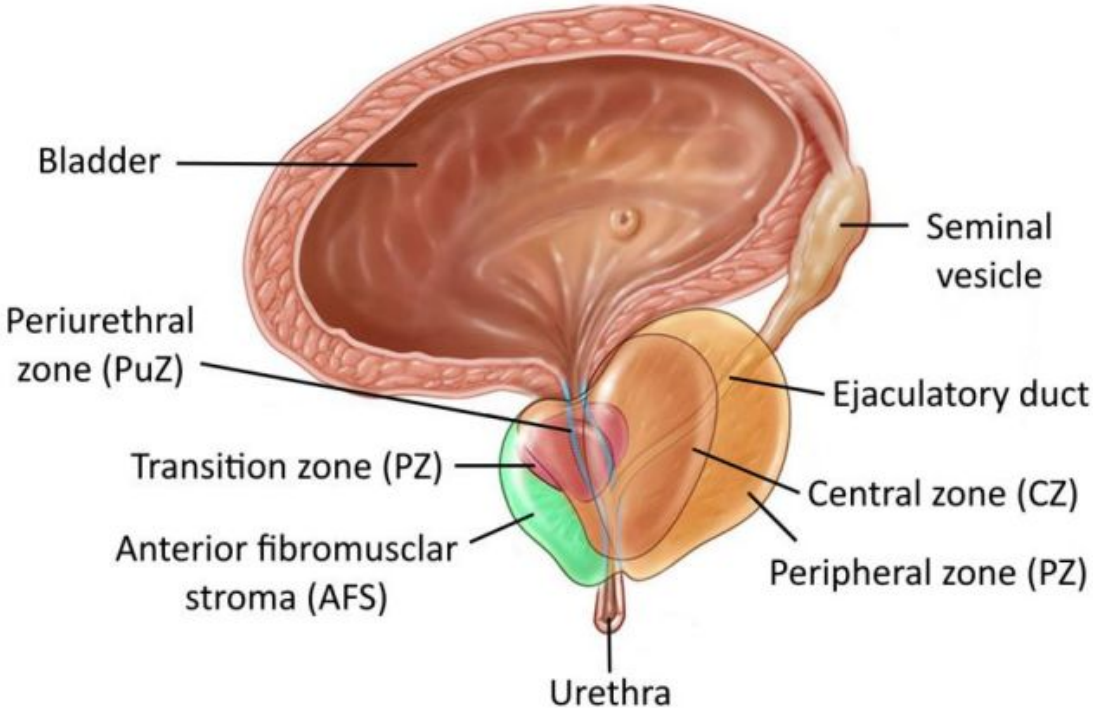
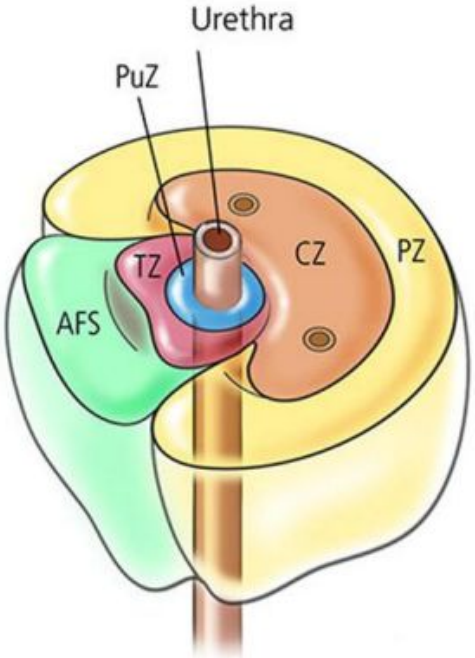
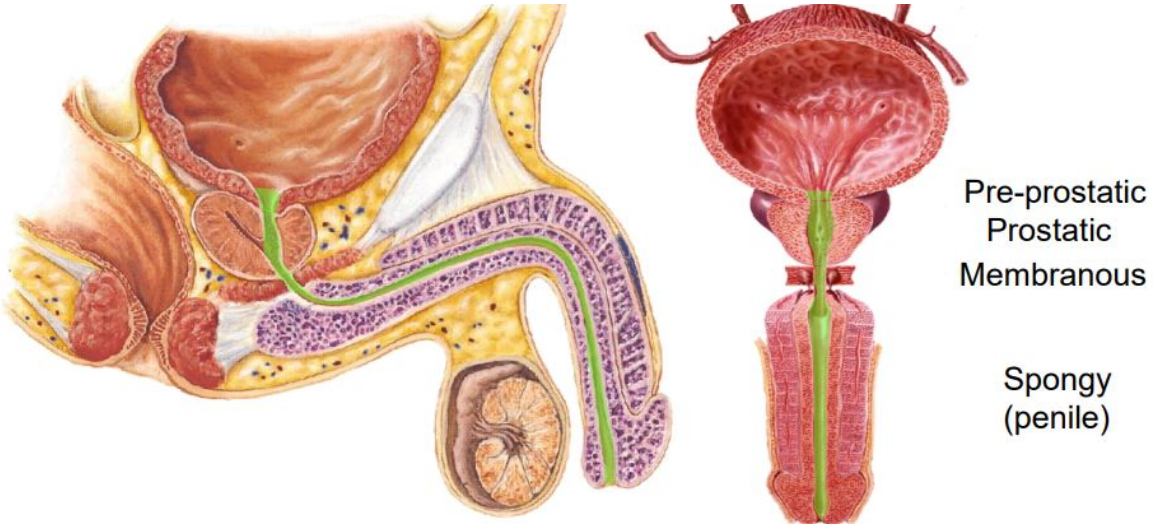
Zones of the Prostate Gland





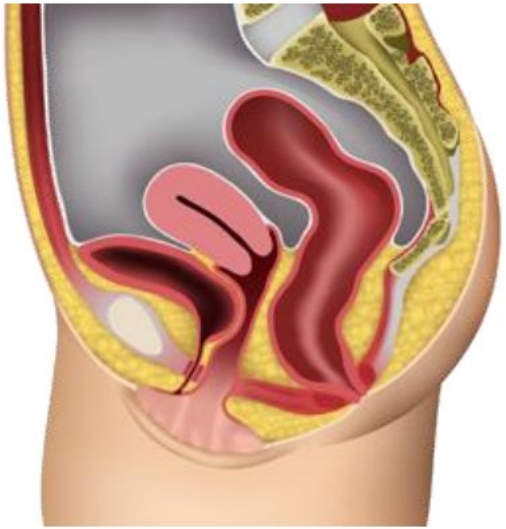
Male Urethra

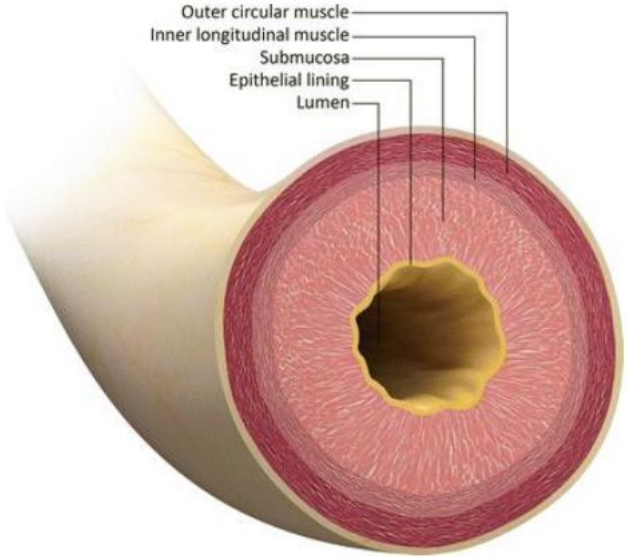
- The urethra in the male passes from the neck of the bladder, through the penis to the external urethral meatus
- As it leaves the bladder, it passes through the prostate gland
- As it leaves the prostate gland, it passes through the deep perineal pouch, and this section is known as the “membranous urethra”



Female Urethra

- The female urethra is much shorter than the male one
- It has few relations and only passes through the deep perineal pouch
- The lumen is kept closed, unless urine is being passed, and this helps to reduce infections.





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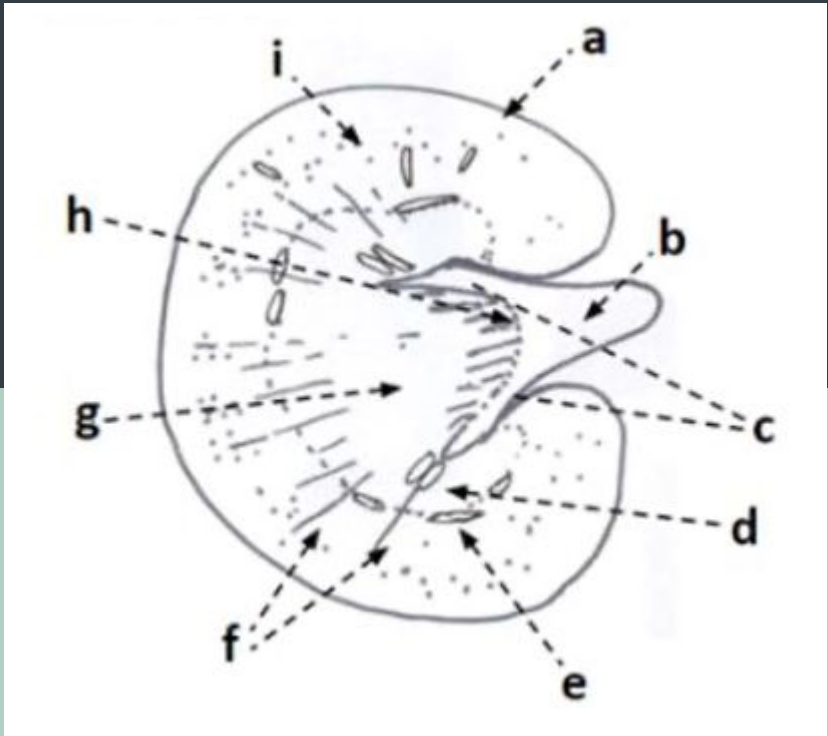
Questions?

SBA 1

Identify the feature labelled (a) in the monkey kidney drawing



a. Cortex
b. Renal capsule
c. Pelvis of ureter
d. Medulla
e. Renal papilla

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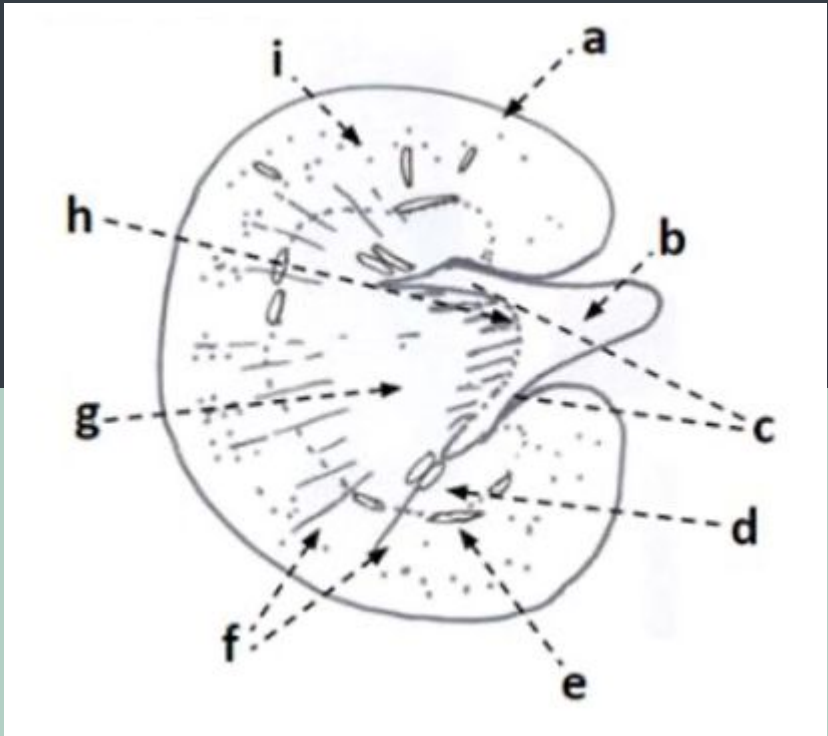
SBA 1 Answer

Identify the feature labelled (a) in the monkey kidney drawing



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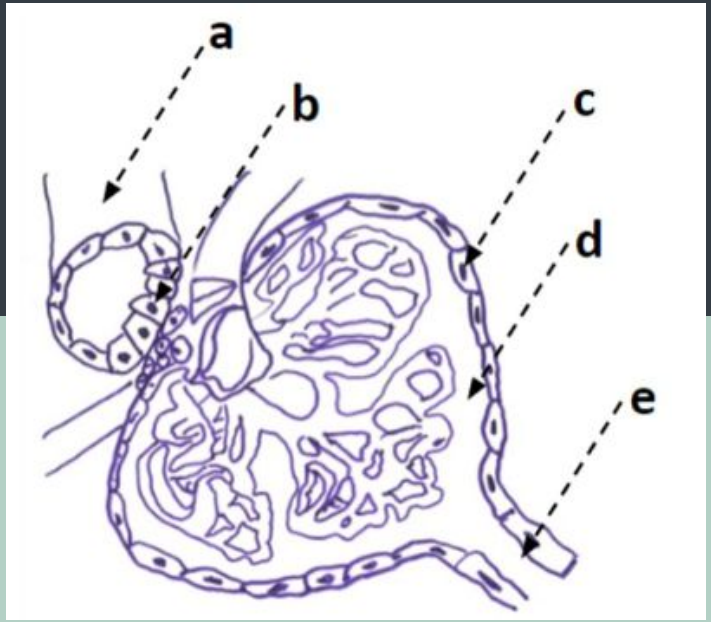
SBA 2

Identify the feature indicated by the arrow labeled A



a. Proximal convoluted tubule
b. Bowman's space
c. Bowman's capsule
d. Macula densa
e. Distal convoluted tubule

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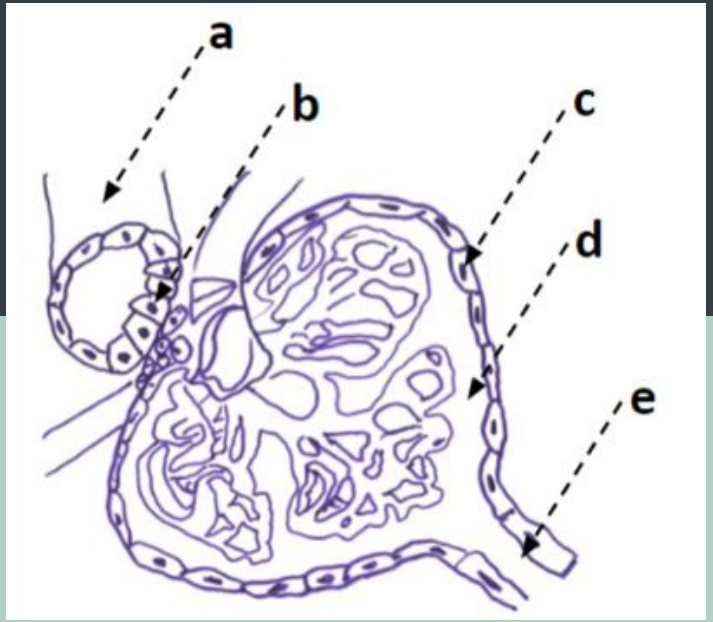
SBA 2 Answer

Identify the feature indicated by the arrow labeled A



a. Proximal convoluted tubule
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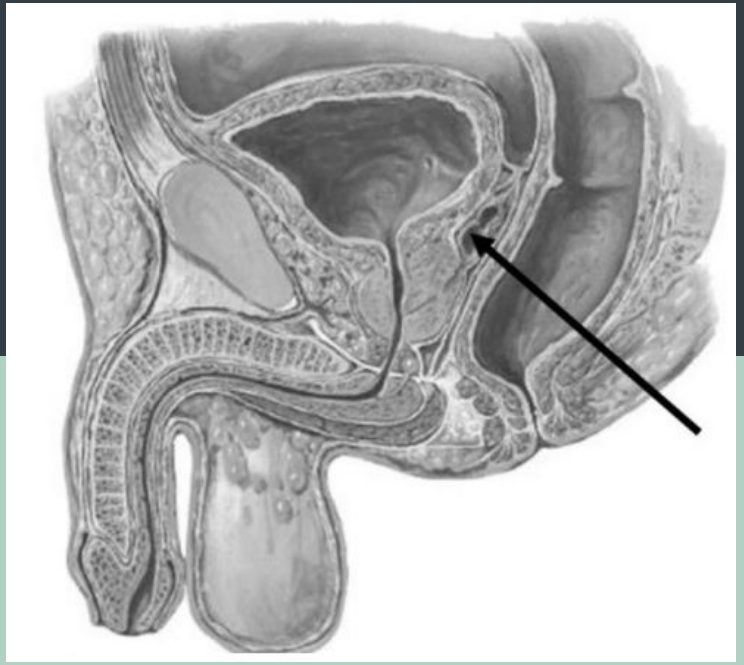
SBA 3

In the figure, which represents a sagittal section of the pelvis, what is the structure labelled by the arrow?



a. Bulbourethral gland
b. Descending colon
c. Prostate
d. Seminal vesicle
e. Sigmoid colon

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SBA 3 Answer

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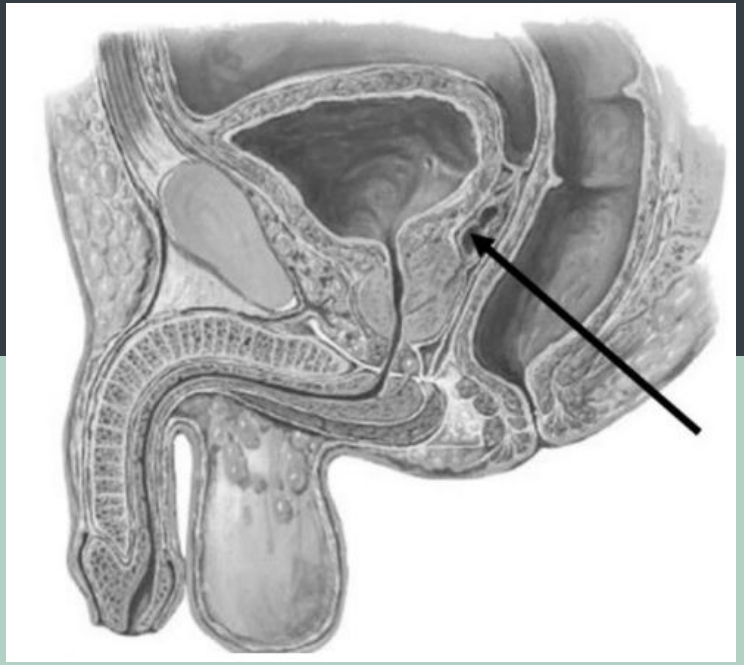

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SBA 4

Which one of the following correctly identifies a pair of arteries that branch off the internal iliac artery?

a. Inferior epigastric and cremasteric artery
b. Deep circumflex and cremasteric artery
c. Inferior vesical artery and inferior epigastric artery
d. Superior and inferior vesical arteries
e. Superior vesical and deep circumflex artery

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Questions?

You should now be able to…

- Describe the **structure** of the whole **kidney**
- Describe the histological features of the: **renal corpuscle**, filter (**glomerulus** and **podocytes**), **convoluted tubules**, **loop of Henle, juxtaglomerular apparatus, collecting ducts, papilla, ureter** and **bladder**
- Give a detailed account of the anatomy of the structure of the **ureter**, its arterial supply, innervation, its course and relations
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- Describe the anatomy of the **urethra** and give an account of its different parts in males and females

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Thank you for attending the session

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